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Gender gap reduction and the one health benefits

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ABSTRACT

Several factors including gender, age groups, cultures and social conditions may affect significantly the risk of diseases and their clinical evolution. Unfortunately, little research has been carried out on these aspects and, consequently few guidelines or interventions have been implemented. In particular, gender is considered a main determinant of inequalities in living conditions, access to health services and, thus, in health protection.

Focusing on the gender gap, we propose an ecological approach to find relationships between quantitative indicators of the gender gap dimension, the environmental performance index and the life expectancy at birth as summary of human health index in 155 countries. We speculated on the consequences of wider gender gaps to the population and environmental health. We further explore these relationships considering gender gap and environmental aspect subindexes, to identify determinants that should be addressed to maximize the One Health effect. We found that the gender gap in educational attainment followed by the political empowerment were strongly correlated with life expectancy, environmental health, and ecosystem vitality.

Addressing gender issues, particularly the education attainment and political empowerment, can provide positive impact beyond the social dimension and the population health, and gender should be component of the One Health approach. We recommend gender targeted interventions that integrate these aspects into One Health national policies.

1. Introduction

In 2005, an international commission of the World Health Organization (WHO), explored the effects of socio-cultural and economic factors on health, demonstrating that gender is a main determinant of inequalities in living conditions, access to health services and, thus, in health protection [1]. From this document many steps forward have been made, but still, most of the work is theoretical and does not consider gender as a global issue.

The word 'gender' indicates the sum of those roles and behaviors determined by the social context learnt and adopted differently by men and women that, eventually, lead to different identities and roles considered especially suitable for men and women [2]. Gender, thus, being a product of social and cultural environment may greatly vary from one society to another and it can also change over time.

Gender interacts with sex, i.e. the biological component, to influence health and disease processes in individuals. Biologically, women are considered to be less at risk to develop most infectious diseases than men due to sex-based impact of hormonal and chromosomal control of immunity, although pregnancy is a period of increased susceptibility to infections and severe illness. Gender, on the other hand, is a social determinant of health as gender norms, roles and relations influence people's susceptibility to health conditions and their access to health services for the prevention and control of infectious diseases. As a result, women, because of gender disparities, are at higher risk and experience a more severe course of illness than men for example for many infectious diseases [3].

The Global Gender Gap report measured quantitatively the inequalities between males and females by defining four fundamental categories (subindexes): 1) Economic Participation and Opportunity, 2) Educational Attainment, 3) Health and Survival and 4) Political Empowerment and collecting data on how Countries perform in the identified categories [4]. The same report defines the gender gap as "the difference between women and men as reflected in social, political, intellectual, cultural, or economic attainments or attitudes".

Addressing such inequalities through interventions driven to reach equity and recognition of human rights is nowadays a central need of every society pushed to adopt the so called 'gender mainstreaming', i.e. the process able to ensure that "women's as well as men's concerns and experiences" are integrated into "the design, implementation,

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monitoring and evaluation of policies and programs" [5].

In the last years, globalization has prompted research on human and animal health to shift from primary health concerns to very complex issues. Many of these issues are related to the increase in human population especially in urban environments, intensive farming, the spread of humans and the consequent increase of trade, traffic, and other developments into natural areas. The concept of "ecosystem health" or "eco health" extends the concept of "one medicine", from the relationship between humans and animals for nutrition, survival, and health to the whole ecosystem [6]. To measure the status of ecosystem health and vitality the Environmental Performance Index represents a useful tool to provide a comprehensive view of the sustainability levels [7].

The Eco health approach takes in account the strong connection among ecosystems, society, animal health, and humans. The negative impact of zoonoses and other emerging diseases on both human health and food security causes great concern. Several factors including gender, age groups, cultures and social conditions, may affect significantly the risk of diseases and their clinical evolution. Unfortunately, little research has been carried out on these aspects and, consequently, few guidelines or interventions have been implemented.

The conceptual framework that links the gender inequities with animal, plant and human health issues was described by Bagnol et al. (2015) [8] who identified the following four factors:

1. Social, Economic, Legal, Cultural and Political Factors Influence How Men and Women Impact the Environment
2. Men and Women Experience Different Health Risks
3. Human, Animal and Plant Diseases Impact Men and Women Differently
4. Biological Differences Between Men and Women influence the response to infections

These factors all together may differently modulate the interactions among gender, animal, human, plant and ecological health.

Further elaboration extended "One Health", "ecosystem health", "systems biology" conceptual thinking towards the "health in social-ecological systems". In this regard, the issue health of humans and animals was explicitly included as a quantitative and qualitative factor and a relevant outcome in social-ecological systems [6]. Zinnstag et al. (2012) provided a new definition of 'One Health' as the sum of any added value in terms not only of human and animal health, but also of financial savings and environmental benefit arising from the close cooperation of all sectors focused on human and animal health protection at all levels of organization [9].

The One Health challenges and risks associated with gender roles at the interface among human, animal and wildlife were described by Garnier et al. (2020) with examples of Emerging Infectious Disease and Endemic Zoonotic Diseases, that present differences in risks due to different gender-related exposure (e.g. hunters, wild meat preparation, family caregivers etc.) that have not been evaluated previously [10]. Regarding the role of women at the interface, their share in agriculture is underestimated, they experience large barriers to health education and gender-normed services that leads them to increased exposure to health risks and to Emerging Infectious Diseases [10].

Focusing on the gender gap, we propose an ecological approach to find relationships between quantitative indicators of the gender gap dimension provided by the Global Gender gap report [4], the environmental performance index [7] and the life expectancy at birth as summary human health index (Human Development Reports' n.d.). We further explore these relationships considering the gender gap and environmental subindexes, to identify determinants that should be addressed with targeted interventions aimed to maximize the One Health effect.

2. Methods

We extracted data on the gender gap from the index and the scores derived by the four main components of the index (Economic Participation and Opportunity, Educational Attainment, Health and Survival and Political Empowerment subindexes) from the Global Gender Gap report 2021 [4]. The index and subindexes provided the proportion of the gender gap filled, having 1 = no gender gap. Data were available for 156 countries. The Environmental Performance Index and the two subindexes Ecosystem vitality and Environmental health were obtained from the 2020 environmental performance index [7]. These indexes overall ranged between 11.8 and 99.3 and the data were available for 180 countries.

The 2019 Life expectancy at birth expressed as an index was downloaded from the Human development report website and was available for 191 countries [11]. The index varies from 0 to 1 indicating with 0 a life expectancy at birth of 25 years and with 1 a life expectancy at birth of 85 years.

For the analyses, in order to have the indexes range comparable, the gender gap and the life expectancy indexes were multiplied by 100.

The strength and direction of association between the gender gap index (and subindexes), the environmental performance index (and subindexes) and the life expectancy index was explored with Spearman's rank-order correlation test. Correlation was considered when rho$\geq$0.25 with $p \leq 0.05$.

3. Results

The final dataset included 155 countries for which all data were available (see supplementary table). The distribution of the indicators is described in Table 1.

The gender gap showed a significant ($p < 0.05$) correlation with the life expectancy (Fig. 1A, rho = −0.41) and ecosystem performance (Fig. 1B, rho = −0.53). Positive significant correlation was observed also between life expectancy and ecosystem performance (Fig. 1C, rho = 0.85).

Fig. 2 summarizes the direction of the correlations among gender gap, life expectancy and ecosystem performance as resulted from the Spearman's rank-order correlation test. All the considered indexes were significantly correlated ($p < 0.05$). The Fig. 2 also presents the optimal interaction among the different indexes, with the tips of the pyramids that indicate the direction of the correlation and the green shade that indicates the optimal condition of interaction: if gender gap is reduced (moving from the basis of the corresponding pyramid towards the tip),

Table 1
Distribution (median, range, and mean) of the indicators considered in the study.

Indicator	Minimum - maximum value	Median (25°-75° percentiles)	Mean ± SD
Gender gap	10.8–55.6	28.9 (25.4–33.4)	29.52 ± 6.71
-Educational Attainment	*51.40–100*	*99.2 (95.4–99.9)*	*95.41 ± 8.41*
-Health and Survival	*93.5–98.0*	*97.0 (96.5–97.8)*	*97.01 ± 0.93*
-Economic Participation and Opportunity	*18.0–91.5*	*68.7 (60.4–74.3)*	*65.89 ± 12.79*
-Political Empowerment	*24.0–100*	*80.4 (68.1–87.9)*	*76.40 ± 15.54*
Ecosystem performance (index)	22.6–82.5	44.8 (34.7–55.6)	47.66 ± 15.89
-Ecosystem vitality	*23.6–76.4*	*46.2 (38.2–55.9)*	*47.81 ± 12.46*
-Environmental health	*11.8–99.3*	*45.1 (26.7–60.2)*	*47.43 ± 24.41*
Life expectancy	51.2–99.4	84.6 (73.8–90.4)	81.87 ± 11.47

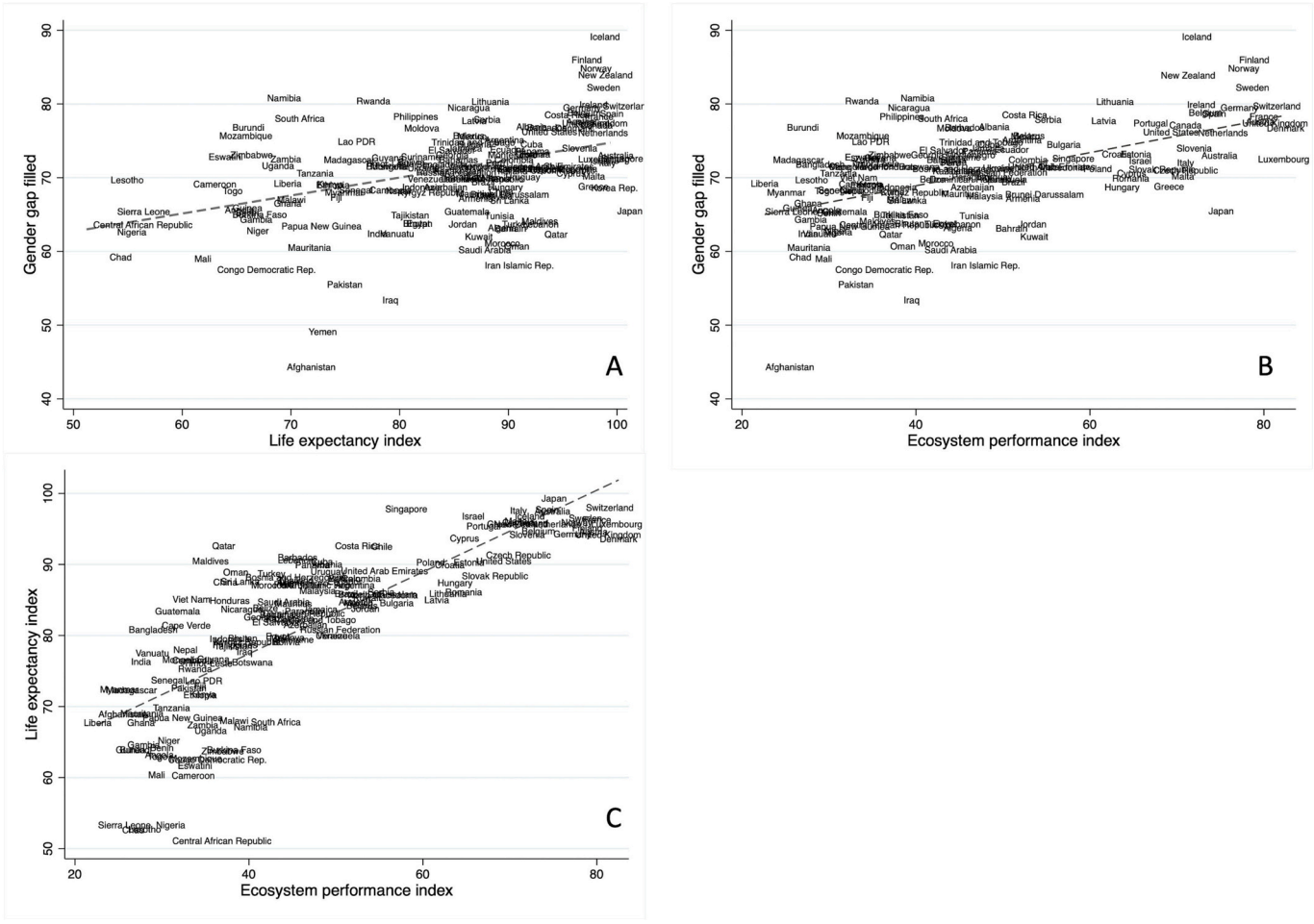

Fig. 1. Correlation by country between gender gap, life expectancy (A; rho = −0.41, $p < 0.01$), ecosystem performance (B; rho = −0.53, $p < 0.01$), and the correlation between life expectancy and ecosystem performance (C; rho = 0.85, $p < 0.01$, as resulted from the Spearman's rank-order correlation test ($p < 0.05$ – the dashed grey line fits a linear prediction).

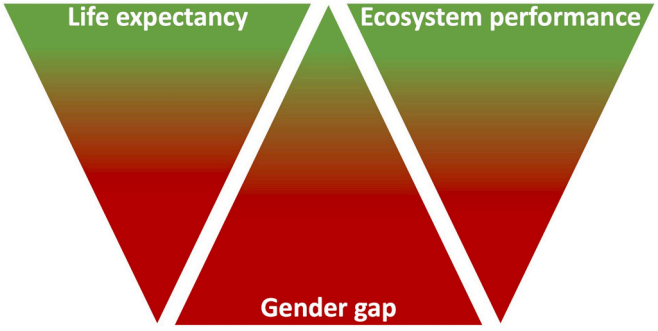

Fig. 2. Interpretation of the correlation among gender gap, life expectancy and ecosystem performance. In red the worst condition (short life expectancy, large gender gap, limited ecosystem performance), in green the optimal conditions (long life expectancy, small or no gender gap, optimal ecosystem performance). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

the increased life expectancy and ecosystem performance is represented by the movement from the tips to the basis of the corresponding pyramids.

Considering the gender gap subindexes (Table 2), we observed that the educational attainment was the one that showed the most intense correlations, followed by the political empowerment, and both were positively correlated with life expectancy, environmental health, ecosystem vitality. The economic participation and opportunity index was positively correlated with environmental health, ecosystem vitality, while the health and survival subindex negatively correlated with life expectancy (rho = −0.278, $p < 0.01$).

4. Discussion

Our analysis points out that gender-oriented policies aimed at reducing the gender gap, in particular in the educational achievements and political empowerment dimensions, should have a much broader positive effect, not only on the society, but also on the ecosystems and, potentially, also on animal health, with a promotion of the “One Health” vision.

The correlations among gender gap, life expectancy and ecosystem performance highlight the improvement of the health and environmental indicators if the gender gap is reduced. This result points out the complex interconnection between gender, health, environment and social aspects that link them.

Significant disparities exist, across and within various geographical areas, in the distribution of the indicators that we considered, with the countries of the Western Europe being often the best ranking ones, and countries in the Middle East and Africa regions remaining those with the largest gaps.

The widest gender gaps were in the political empowerment, economic participation and opportunity, and educational attainments dimensions; however, the educational attainment is the only one that

Table 2
Correlation (rho) between the different subindexes of the gender gap (educational gap, health gap, economical gap and political gap), the life expectancy as general indicator of population health, the two indicators of environmental performance; the overall environmental health and the ecosystem vitality and the indicator of animal health (only the rho values of the statistically significant correlations – $p < 0.05$ – are displayed).

	Gender gap				Population health	Ecosystem performance	
	Educational gap	Health gap	Economical gap	Political gap	Life expectancy	Environmental health	Ecosystem vitality
Educational gap	1						
Health gap	NS*	1					
Economical gap	0.326	0.264	1				
Political gap	0.348	NS*	0.227	1			
Life expectancy	0.642	−0.286	NS*	0.313	1		
Environmental health	0.706	NS*	0.178	0.343	0.927	1	
Ecosystem vitality	0.595	NS*	0.213	0.362	0.594	0.652	1

* Not statistically significant.

strongly correlates with ecosystem and population health, measured by ecosystem vitality, environmental health and life expectancy. The impact of the education on health status, in particular of women education was described by the WHO Commission on Social determinants of health in the 2008 report ([12] and discussed by Raphael et al. (2020) [13]. People with higher education tend to be healthier than those with lower educational attainment, because level of education is highly correlated with other social determinants of health such as the level of income, employment security, and working conditions. Focusing on women, access to education is considered the best predictor of their children's health, thus directly impacting not only on their health conditions, but also on future generations' health [14]. The impact of the level of education on the environment can be interpreted within the broader relationship with nature, which is mainly based on social and ideological constructions. Environmental problems tend to be strongly influenced by lack of knowledge and education, and socioeconomic status determinants such as income, employment and education are strongly related to environmental health, that could be directly and indirectly modulated by gender [15,16].

In general, women have less access to information, education, labor, and decision making; all these factors together contribute to the lower economic and social power of girls and women hindering to define how to build their relationship with the environment [8].

In the family and community contexts, women play a pivotal role in managing natural resources, but local laws and customs often do not allow them the direct control of those resources (ownership or leasing of lands) nor the possibility to access to loans or insurance.

Although women are producers and farmers, they have been limited access to education, information and input. This means that women most likely are impacted more heavily than men in case of environment degradation or events of animal and plant diseases. Finally, taking in account the key role played by women in environment preservation, they have to be involved in the interventions aimed at protecting natural resources and ecosystems, ensuring them adequate information, education, roles, and resources.

To date, there is no generally accepted index of animal health that can be used in our analyses. A number of indices have been proposed to measure the status of animal health in regions or countries with respect to specific diseases, but none have been applied on a large scale [17,18]. Although this gap may limit our “One Health” approach, it can nevertheless be hypothesized that many human social determinants of health are directly and indirectly related to animal health and thus may have an influence on it [19]. The One Health and gender are linked at the human-animal-environment interface, where gender affects exposure, particularly to zoonoses and emerging infectious diseases depending on the social/occupational roles played by women and men in the community [8,10,20,21].

The negative correlation between the gender gap in health and survival and the life expectancy is mainly the consequence of a reduced variability of this index and the reduced life expectancy in many countries, especially in Africa, that have among the smallest gender gap in health. It seems that the gender equivalence in health and survival is often a condition related to the capacity of the health systems, and where this capacity is limited, the gender gap is smaller, but we don't have any clear explanation of it.

Our ecological analysis presents some limitations: the proposed indexes are well established, validated and widely recognized, but in the animal health domain there are not recognized indexes and our speculations on the effect on animal health of the gender gap index and subindexes are not supported by data.

The proposed macro-level analysis provides indications more than clear results, but it underlines areas of intervention that need to be explored more in detail. Concerning the gender gap in the political empowerment, the relationships it showed with life expectancy, environmental health, ecosystem vitality were similar to those observed for education attainment, to which it was related. Unequal opportunities of participation to political life between men and women are still operating worldwide. The policies related to development are largely defined by men, while women, and especially the poor ones, have to deal with the consequences of men's decisions.

To promote the holistic One Health vision in a sustainable way and preserve the environment and the populations that live in it, resources and opportunities should be equally accessible to women and men without disparities, Sustainable development and effective prevention strategies must aim to reduce the actual gender gap, to foster women's empowerment and effective participation.

Among the possible interventions to mitigate gender inequalities, those aimed at facilitating the access of women to better education and information, in our opinion, should provide the highest positive impact.

In conclusion, addressing gender issues is urgent and fundamental to reduce the risks at the human-animal-environmental interface and to promote targeted public health interventions within the One Health approach. To meet this goal and provide meaningful local representations of gender impacts on the human/animal/environmental interface, we pointed out the reduction of the gender gap, in particular in the educational attainment and the political empowerment, that should be addressed with targeted interventions integrated into One Health national policies. Such reduction could positively impact not only the social and health dimensions, but also the ecosystems and the environment.

Author statement

CC ideated the manuscript and contributed to the writing.
RM contributed to the writing and the revision of the manuscript.
LB made the analyses, contributed to the writing and the revision of the manuscript.

Declaration of Competing Interest

None.

Data availability

Data are publicly available and data sources are mantioned in the references

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.onehlt.2023.100496.

References

[1] K. Lee, M. Koivusalo, E. Ollila, et al., Globalization, Global Governance and the Social Determinants of Health: A Review of the Linkages and Agenda for Action. https://www.who.int/social_determinants/resources/gkn_lee_al.pdf, 2007.
[2] Gender, Health and Theory: Conceptualizing the Issue, in Local and World Perspective – ScienceDirect. https://www.sciencedirect.com/science/article/abs/pii/S0277953611003509, 2022 (accessed 23 May 2021).
[3] J. Garnier, S. Savić, N. Cediel, et al., Mainstreaming gender-responsive one health: now is the time, Front. Public Health 10 (2022), 845866, https://doi.org/10.3389/fpubh.2022.845866.
[4] Global Gender Gap Report, World Economic Forum. https://www.weforum.org/reports/global-gender-gap-report-2021/, 2021 (accessed 30 Jul 2021).
[5] V. Magar, S. Heidari, G. Zamora, et al., Gender mainstreaming within WHO: not without equity and human rights, Lancet 393 (2019) 1678–1679, https://doi.org/10.1016/S0140-6736(19)30763-9.
[6] J. Zinsstag, E. Schelling, D. Waltner-Toews, et al., From "one medicine" to "one health" and systemic approaches to health and well-being, Prev. Veterin. Med. 101 (2011) 148–156, https://doi.org/10.1016/j.prevetmed.2010.07.003.
[7] Z.A. Wendling, J.W. Emerson, A. de Sherbinin, D.C. Esty, et al., 2020 Environmental Performance Index. https://epi.yale.edu/downloads/epi2020report20210112.pdf, 2020.
[8] B. Bagnol, R. Alders, R. McConchie, Gender issues in human, animal and plant health using an Ecohealth perspective, ENRR 5 (2015), p62, https://doi.org/10.5539/enrr.v5n1p62.
[9] J. Zinsstag, A. Meisser, E. Schelling, et al., From 'two medicines' to 'one health' and beyond, Onderstepoort J. Vet. Res. 79 (2012) 5, https://doi.org/10.4102/ojvr.v79i2.492.
[10] J. Garnier, S. Savic, E. Boriani, et al., Helping to heal nature and ourselves through human-rights-based and gender-responsive one health, One Health Outlook 2 (2020) 22, https://doi.org/10.1186/s42522-020-00029-0.
[11] Human Development Reports. http://hdr.undp.org/en/indicators/103206, 2022 (accessed 14 Dec 2021).
[12] Closing the gap in a generation: health equity through action on the social determinants of health - Final report of the commission on social determinants of health. https://www.who.int/publications-detail-redirect/WHO-IER-CSDH-08.1, 2022 (accessed 3 Feb 2022).
[13] D. Raphael, T. Bryant, J. Mikkonen, et al., Social Determinants of Health: The Canadian Facts, 2020.
[14] H. Wamani, T. Tylleskär, A.N. Åstrøm, et al., Mothers' education but not fathers' education, household assets or land ownership is the best predictor of child health inequalities in rural Uganda, Int. J. Equity Health 3 (2004) 9, https://doi.org/10.1186/1475-9276-3-9.
[15] F. Ramírez, J. Santana, Environmental education and biodiversity conservation, in: Environmental Education and Ecotourism, Springer International Publishing, Cham, 2019, pp. 7–11, https://doi.org/10.1007/978-3-030-01968-6_2.
[16] M. Braubach, M. Martuzzi, F. Racioppi, et al., On the way to Parma: understanding and addressing the influence that social inequities have on environmental health, Europ. J. Public Health 20 (2010) 12–13, https://doi.org/10.1093/eurpub/ckp215.
[17] A. Zavala-Cortés, G. Hernández, J.-V. Calderón-Salinas, An index for multidimensional assessment of swine health, Trop. Anim. Health Prod. 53 (2021) 75, https://doi.org/10.1007/s11250-020-02552-8.
[18] P. Depoorter, X. Van Huffel, H. Diricks, et al., Measuring general animal health status: development of an animal health barometer, Prev. Vet. Med. 118 (2015) 341–350, https://doi.org/10.1016/j.prevetmed.2014.12.008.
[19] C. Card, T. Epp, M. Lem, Exploring the social determinants of animal health, J. Vet. Med. Educ. 45 (2018) 437–447, https://doi.org/10.3138/jvme.0317-047r.
[20] A.H. Coyle, A.M. Berrian, J. van Rooyen, et al., Gender roles and one health risk factors at the human-livestock-wildlife Interface, Mpumalanga Province, South Africa, Ecohealth 17 (2020) 233–247, https://doi.org/10.1007/s10393-020-01478-9.
[21] R.R. Ghai, R.M. Wallace, J.C. Kile, et al., A generalizable one health framework for the control of zoonotic diseases, Sci. Rep. 12 (2022) 8588, https://doi.org/10.1038/s41598-022-12619-1.